Rise And Set iP

User's Manual

version: 2011 10 29

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What You Have

Rise And Set iP is an iPhone application intended for use by Amateur Astronomers, especially Visual Astronomers. ***Rise And Set iP*** will:

- Assist you in finding North, South, East or West
- Give you your current Latitude and Longitude
- Allow you to track to a location (within about 4m)
- Calculate the
    - Sunrise, Sunset
    - Moonrise, Moonset
    - Civil, Nautical and Astronomical Twilight start and end times
    - Number of daylight hours and number of night time hours
- Calculate the above for any latitude/longitude pair of an astronomical year within J2000 from JD 0 on.

All of the above can be done from a single view.

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Notes

- “dd” stands for degrees latitude
- “ddd” stands for degrees longitude
- “mm” stands for minutes of a degree or minutes of an hour.
- “ss” stands for seconds of a degree or seconds of a minute.
- “hh” stands for hours of a day.
- Latitude is entered and displayed as degrees, minutes and seconds north or south.
- Longitude is entered and displayed as degrees, minutes and seconds west or east.
- The symbol ° stands for degrees of latitude or longitude.
- The symbol ' stands for minutes of latitude or longitude.
- The symbol ” stands for seconds of latitude or longitude.
- The term “widget” is any icon on a screen of any type: button, text field, etceteras.
- The symbol ± indicates a plus or minus sign.
- AL VS indicates Always Visible
- NOVIS indicates Not Visible
- DARK indicates twilight never ends.
- BRIGHT indicates twilight never starts.

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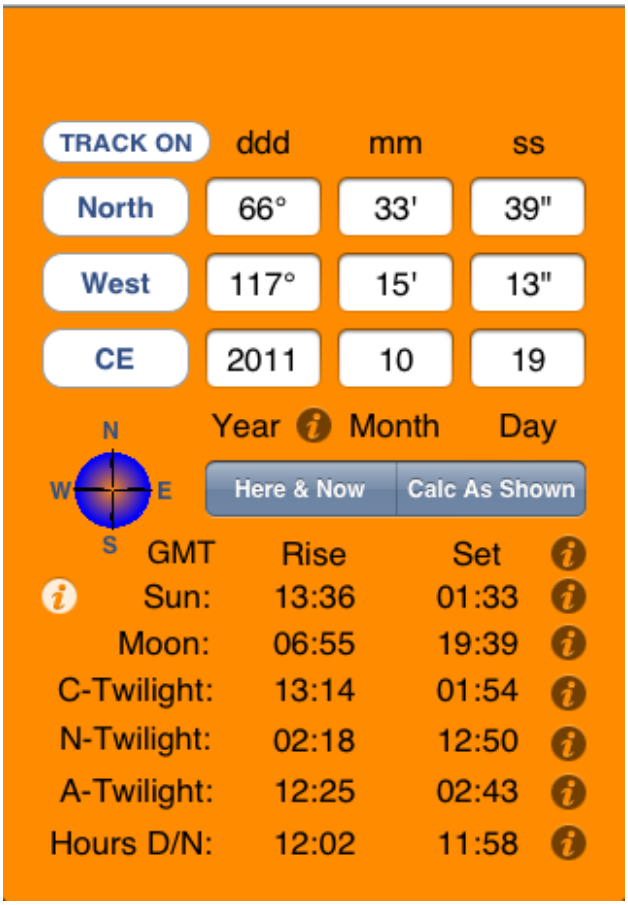
Finding Your Way Around The *Rise And Set iP* View



Track On/TrackOff Button Location

Starting from the top and left side of the view the first item is the TRACK ON button. This button is used to turn the Latitude/Longitude tracking button on or off.

ddd mm ss: Degrees Minutes Seconds Location

To the immediate right of the TRACK ON button are three letter groups standing for degrees (ddd) minutes (mm) and seconds (ss). These mark columns indicating degrees, minutes and seconds of either Latitude or Longitude.

Latitude Row Location

Just below the TRACK ON button is the Latitude row: North 000 00 00 . This row contains several controls. A button for indicating if the latitude is north or south. And

three edit boxes to allow you to enter the degrees, minutes and seconds of a latitude or view the current latitude as degrees, minutes and seconds.

Latitude Row Location

Below the Latitude row is the Longitude row: 

containing similar controls for the the Longitude. The east/west button, degrees, minutes and seconds edit fields are grouped exactly as the Latitude row is grouped.

Astronomical Year Information Row Location

Continuing downward the next control is the Astronomical Year Information Row containing a CE/BCE button and a grouping of three edit fields for the year, month and day of interest:


Astronomical Year Information Header Row Location

Below the Astronomical Year Information Row is the Astronomical Year Information Header Row: 

Note the Info button between the words “Year” and “Month”.

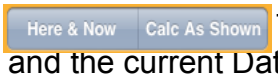
Compass Rose Location

Below and to the left is the Compass Rose: 

The Compass Rose, “N”, “E”, “S” and “W” are buttons. They control what direction you may want to find.

The Compass Rose also acts as a cancel button in case you want to stop the search for “N”, “E”, “S” or “W”.

Here & Now/Calc As Shown Location

To the right of the Compass Rose are two selection buttons: 

The Here & Now button will read he current GPS Latitude and Longitude and the current Date and Time before doing the ***Rise And Set iP*** calculations. While Calc As Shown will use the values you have entered into the edit fields for latitude, longitude and Astronomical Year.

Time, Rise And Set Information Row Location

From left to right, “GMT” represents the nature of the hour and minutes. GMT means the times shown are based on GMT and no daylight savings is used. If instead the letters “LCL” are shown then the hours and minutes are shown as local time including daylight saving time and timezone offset. “LCL” is always the default as long as you use “Here & Now”. If you enter a longitude and latitude then if the degrees and minutes are the same as your current

latitude and longitude degrees and minutes, LCL will be the default. If the degrees and minutes not the same as your current location then GMT is applied instead.

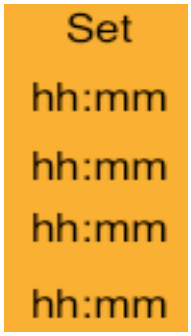
Rise Column Location

Below the Here & Now/Calc As words: “Rise” and “Set”. Each of the be found just below the words: The represents (from top to bottom) moonset, civil twilight start and end, astronomical twilight start and end, hours.

Shown selection buttons are two words identifies a column that can “hh:mm” for each column sunrise, sunset, moonrise, nautical twilight start and end, total daylight hours, total night time

Set Column Location

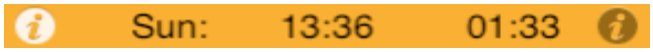
To the Right of the Rise Column Location is the Set Column. each column represents (from top to bottom) Sunset, Twilight Start, Total night-time hours.



The “hh:mm” for Moonset, Nautical

Sunrise/Sunset Row Location

From left to right, starting with the word “Sun” is the Sun Information Row:



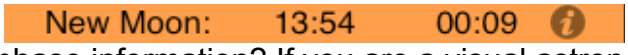
The “hh:mm” represents the time of (from left to right) Sunrise and Sunset. The information button to the right contains information about the definitions of Sunrise and Sunset.

Moonrise/Moonset Row Location

From left to right, starting with the word “Moon” is the Moon Information Row:

The “hh:mm” represents the time of (from left to right) Moonrise and Moonset. The information button to the right contains information about the definitions of Moonrise and Moonset.

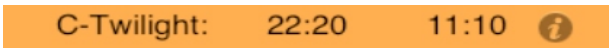
If the date used to calculate the moonrise and moonset results in a New Moon date the word “New” will prefix the “Moon:” label. An example is shown below.



Why not show the other phase information? If you are a visual astronomer you want the best

viewing you can get and that is a new moon. Other phases just have too much light when the moon is up to be visually excited about the moon phase.

Civil Twilight Row Information Location



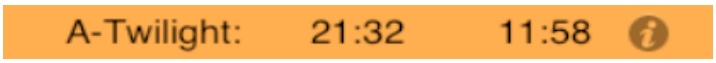
From left to right starting with the word “C-Twilight:” is the start of civil twilight and the end of civil twilight. See the definition of Civil Twilight for the meaning of the words start and end.

Nautical Twilight Row Information Location

From left to right, starting with the word “N-Twilight” is the Nautical Twilight Information Row.

The “hh:mm” represents the time of (from left to right) Nautical Twilight End, Nautical Twilight Start. The information button to the right contains information about the definitions of Nautical Twilight.

Astronomical Twilight Row Information Location



From left to right starting with the word “A-Twilight:” the values are time values in the form hh:mm representing the start and end of Astronomical Twilight. For the definition of astronomical twilight see the information button to the right of the astronomical twilight set time.

Day/Night Length Row Information Location

From left to right the “hh:mm” represent the length in hours and minutes of the length of daylight and the length of night-time:

The information button to the right describes the definitions for day time and night time.

Sun Or Moon Always Visible

There are some latitudes that cause the sun or moon to either be always visible. This condition happens most notably in the northern hemisphere at or above arctic circle region. In the southern hemisphere at or below the antarctic circle region.

The Arctic Circle marks the southern extremity of the polar day (24-hour daylight, sometimes referred to as the “midnight sun”) and polar night (24-hours of night). The same is true in the southern hemisphere but six-months out of phase to the northern hemisphere.

When either the sun or moon are always visible the “hh:mm” values are replaced by the term “AL VS” which stands for the english words “ALWAYS VISIBLE”.

Sun Or Moon Never Visible

There are some latitudes that cause the sun or moon to be always hidden. This condition happens most notably in the northern hemisphere at or above the arctic circle. In the southern hemisphere at or below the antarctic circle region.

The Arctic Circle marks the southern extremity of the polar day (24-hour daylight, sometimes referred to as the “midnight sun”) and polar night (24-hours of night). The same is true in the southern hemisphere but six-months out of phase to the northern hemisphere.

When either the sun or moon are not visible the “hh:mm” values are replaced by the term “NOVIS” which stands for the english words “NOT VISIBLE”.

Twilight Hours Always Dark

Since the sun can be hidden from view there are times when the sun never appears high enough to satisfy the definition for civil, nautical or astronomical twilight. During these times the twilight rise/set times will be set to “DARK”.

Twilight Hours Always Bright

You can be at a latitude that the sun never appears to set. These latitudes will never achieve the definition of civil, nautical nor astronomical twilight. When this condition occurs the “hh:mm” values for twilight will be replaced by “BRIGHT”.

GMT vs LCL: Locale times

If you use the “Here & Now” segment of the 

button you are asking to use the local position. In this case the locale chose is your local position and local timezone along with any applicable daylight saving information will be applied. The time type, left of the word “Rise”, will display LCL.

If you enter a latitude and longitude that is not within one-minute of latitude or longitude of you current position you will be switched to ZULU[1] time (GMT will be displayed left of the word “Rise”).

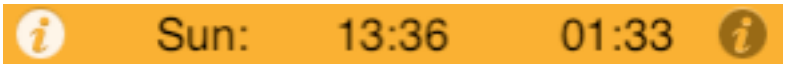
This is true regardless of your date setting. So you can find local rise/set times for days in the future in case you are going to do some viewing next weekend or

1 ZULU does not refer to a geographical region of Africa in this case but to the Military timezone reference to the zero reference line of UTC. Lookup Military Timezones on Wikipedia for more information.

next year from the same location.

If you want to find out the rise/set times for some place on the planet other than where you are (outside of one-minute of latitude or one-minute of longitude) then the times displayed will be ZULU time (GMT).

Rise And Set Information Row Location



Click the information button to get the following view:

Rise And Set iP will speak the version number when you select the above page. This is so you don't have to glance at the phone. So if you are doing some observing and you accidently hit the info button you will hear a version number to let you know you just hit the wrong button.

How To Use Rise And Set iP

Rise And Set iP was designed with two basic criteria in mind:

1. All controls must be usable from a single view.
2. Be useful to the amateur visual astronomer.

The color choice is a night-time visual choice rather than a Halloween choice. Orange text on black backgrounds whenever possible so viewing the text doesn't destroy your night vision.

Soft colors for both day and night viewing to ease your eye strain. Visual astronomy can already be taxing on the eyes bright white lights do not help.

How to Use Tracking

Near the top of the main view you should find a button that looks like this:

If you click on this button two things will happen

1. The iPhone will continually update your GPS position and display the update in the latitude and longitude display using degrees, minutes and seconds.
2. The button text will turn to: 

When you are finished tracking just click on the “TRACK OFF” button to return to a fixed latitude and longitude display.

No map is displayed. This feature is intended to show where you are on a telescope field or observing field. It is specifically not a turn-by-turn feature. So the map is superfluous.

How to Use The Here & Now button

The “Here & Now” button is on the left side of the segmented button as shown above. To find your current latitude and longitude click on the Here & Now side of the segmented button and your latitude/longitude values will populate the degrees, minutes and seconds displays for both latitude and longitude.

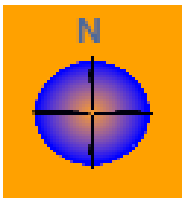
How to use the compass rose

Look at the compass rose icon: the compass indicated with text for West. Each of these primary may click to activate.

The icon has the four primary cardinal points of “N” for North, “E” for East, “S” for South and “W” cardinal point letters is actually a button that you

Once you do activate one of the cardinal point buttons the others will disappear from around the compass rose.

As an example click on the “N” for North. You will now see a compass rose that looks slightly different: The other primary cardinal points have vanished.



Find a flat surface to put your iPhone onto. ***Slowly*** rotate your iPhone.

The logic of ***Rise And Set iP*** looks for a ±2-degrees fit to determine a successful “hit” on your direction. This accuracy is just fine for indicating your direction for your telescope. Since the iPhone is compact rotation of the phone even a small amount can produce a relatively large degree change. So rotate the phone ***slowly***.

While you are ***slowly*** rotating your iPhone listen carefully (make sure your volume is turned up on your iPhone). When you hit the direction you are interested in you will hear the direction spoken (in English) followed by “Okay” (a seemingly universal word that needs NO translation). Once again the cardinal points will return to the compass rose so it looks like:

Without rotating the iPhone any more, stand so you are at the “Home Button” end of your iPhone. Look toward the end of the iPhone furthest from you. You are now facing the direction you were looking for.

Use one of the straight edges of the iPhone as a guide and sight along that edge to guide you in setting up your tripod for your telescope.

Remember to turn the iPhone slowly. If you hear a Nor-East, South-East, South-West or Nor-West you will be able to judge whether you have turned the iPhone too fast. Rotate it back toward the direction that you wanted.

Here is an example of finding North: The left image is rotated 15-degrees toward West and the right image is 15-degrees toward East. If you are too far East, rotate slowly toward the West until you get to North.

When you have rotated to the cardinal point you are searching for the iPhone will speak to you by saying the cardinal point (in english) and then the word “Okay!” If you rotate too far you may hear one of the intermediate cardinal compass points such as Nor-East, Nor-West, South-East or South-West. This is an indication you have gone too far. Simply reverse the direction.

This is a handy tool for initially aligning your telescope. Once you have done the initial alignment follow the user's manual for your telescope to refine the alignment.

How To Cancel Searching For Cardinal Points

The compass rose image is a switch that is activated when you select “N”, “E”, “S” or “W”.

Once you activate one of the cardinal point switches the others will disappear. This also activates the Compass Rose as a switch to cancel the find search.

When you click on the Compass Rose you will hear a click and see the Compass Rose flash followed by the phrase “OKAY” and the cardinal points will reappear.

How To Enter a Latitude

From left to right there are four widgets.

1. North/South hemisphere indicator.
2. Degrees text field.
3. Minutes text field.
4. Seconds text field.

To enter a latitude you must know at least three of these 4 items. North/South hemisphere indicator is required. Degrees is required. Minutes is required. Seconds is desired but not required as you may always enter a value of zero (000).

There are 90 degrees of latitude. Starting at zero degrees latitude at the equator and increasing to 90 degrees of latitude at the North Pole or the South Pole. Southerly latitudes are considered arbitrarily to be negative and northerly latitudes are considered to be positive. +66° 33′ 39″ is the Arctic Circle and -66° 33' 39” is the Antarctic Circle.

Since positive and negative carry connotations of goodness and non-goodness instead of the plus or minus sign the suffix N or S is often used. So 66° 33' 39” N is the Arctic Circle and 66° 33' 39” S is the Antarctic Circle.

When entering a hemisphere indicator in ***Rise And Set iP*** the North and South button is used as a prefix instead of suffixing N or S. For longitude W or E is prefixed.

You may use a plus or minus sign when you enter a value into the degrees, minutes or seconds text fields. The value will be corrected to be North or South (WEST or EAST) and the absolute value of the degrees will be shown instead. Entering a negative value for minutes or seconds will result in the plus or minus sign being ignored and removed.

This does mean that if you are at 00° 01' 01” S you will have to toggle the hemisphere switch yourself as entering a negative zero is the same as entering a positive zero. So 00° 01' 01” will end up being a north latitude not a south latitude.

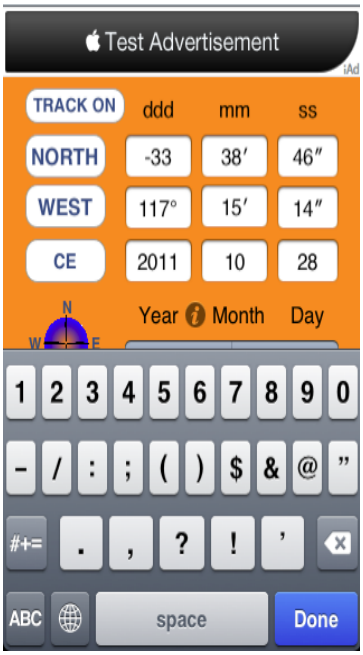
Tap your finger on the degrees text field and the numeric/punctuation keyboard will appear on your iPhone screen:

Use the normal editing keys to enter the value you want to use. In our example we are going to use 66° 33' 39” (the Arctic Circle) to find the time of sunrise, sunset, moonrise, moonset, nautical twilight start and end and the length of the day.

If there is a number in the text field use the delete key to erase the values and type in the number 66. Then press the “Done” key. The value 66° will appear in the degrees edit field.

Repeat this procedure for the minutes and seconds edit fields.

You may try entering punctuation or shifting the keyboard and trying more values but this will only result in warnings and re-entering values. But it is YOUR time to waste.



Example of entering a negative latitude value. Rise And Set iP will detect the negative sign and will strip the negative sign off and replace it with a positive value. At the same time the North/South value will change to South.

Here is an example of the result:

Why To Use a Feature

Why Use Tracking

In large telescope fields you may often be given a latitude and longitude to set up at. Finding the latitude and longitude is sometimes problematical. With ***Rise And Set iP*** just turn on tracking and walk until you get to the latitude and longitude you were given.

Also viewing certain objects is sometimes optimal at a fixed latitude/longitude. The tracking feature of ***Rise And Set iP*** can assist you in finding that latitude/longitude location even from a vehicle.

Don't forget to turn tracking off as the navigation features of the iPhone can drain the battery more quickly than you might realize.

Why Use the Here & Now Button

The 

button is used to obtain your current physical latitude and longitude from the navigation feature found in your iPhone. Click on the left side of this segmented button (“Here & Now”) and ***Rise And Set iP*** will read the values for your current latitude and longitude location and display the results as degrees, minutes and seconds.

This feature has a multitude of uses. The most common is to set up a computerized interface or to enter a latitude and longitude into computer planetarium software for creating an observation map.

It is also useful for geo treasure games and for general hiking. For visual astronomers it is very handy for comet watching and super nova patrol. Noting the latitude and longitude of your observing location for any object that looks unusual in the sky.

Why Use the Compass Rose

The compass rose is there to solve a nasty problem facing many new visual astronomers. When you are setting up a telescope you need a particular part of the scope to point toward North or sometimes South or on some telescopes West or East.

If it is twilight then you may not have Polaris to guide you quite yet. If you are in light-polluted skies then you may not even be able to find Polaris. If you are in the Southern Hemisphere then you bound to the southern cross. Still if it is before twilight then you have a rough idea but not a more exact fix.

Now most modern day computerized scopes will correct for a poor directional alignment but it takes a while and if you want to track something it can be a nightmare unless you align your scope properly to begin with.

That is what the compass rose will help you to do. Look at the compass rose below.

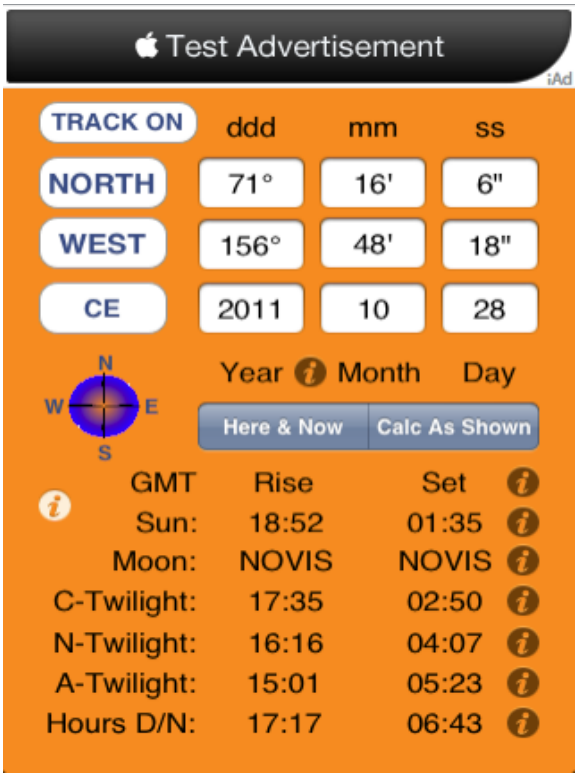
Note that there is an “N”, “E”, “S” and “W” around the outside of the compass rose. These are the cardinal points of the compass representing North, East, South and West respectively. The other cardinal points of the compass (there are actually 16 cardinal points but we only discuss 8 points) are: North-East, South-East, South-West and North-West. If you touch one of the cardinal points of the compass (try touching the “N” as an example) the other cardinal points will disappear leaving on the “N” and the compass rose. Rotate the iPhone slowly (very slowly) until you hear the cardinal point you were searching for “North” for instance followed by the words “Okay”

The Compass Rose with all cardinal points will reappear. You are now facing the direction you wanted (see the How to use the Compass Rose for details).

How To Enter A NOT VISIBLE Latitude Example

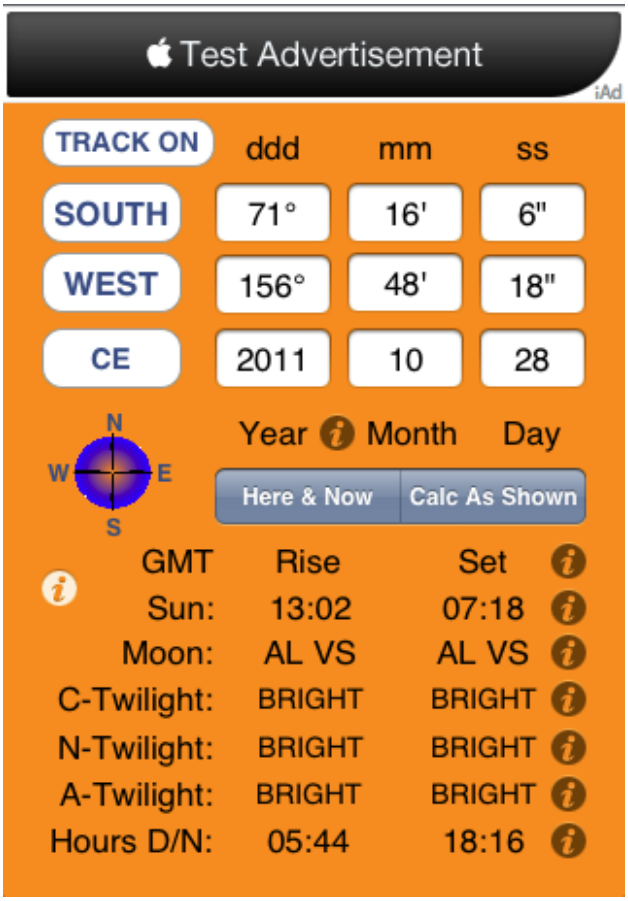
Barrow, AK is located at 71° 16' 06” N 156° 48' 18” W. Barrow will be in a position that the moon will not rise on 2011 October 28.

If you enter the values above and press the “Calc As Shown” segmented button you should see the following display:



How To Enter A ALWAYS VISIBLE Latitude Example

Enter the latitude, longitude and date values for the How To Enter A NOT VISIBLE Latitude Example above and change the hemisphere to SOUTH. Then press the “Calc As Shown” segmented button. You should see the following display:



How To Enter An ALWAYS BRIGHT Twilight Example.

Use the same values as the How To Enter A ALWAYS VISIBLE Latitude Example. Press the “Calc As Shown” segmented button and notice that the twilight values indicate BRIGHT. The reason is that the sun rises at 13:02 in the afternoon and sets at 07:18 the next morning. No twilight can happen.

Accuracy

Floating Point Package Accuracy

One of the things that will affect your accuracy is the floating point library package used to represent non-integer numbers.

If you are not a computer person nor a mathematician the previous sentence may have made no sense to you. Lets do an example to show you what is going on. There is a common example shown in most high school math classes that illustrates the point quite well.

> Example: A number can have a non-terminating decimal value (don't panic now---this is really very easy). For instance 1 divided by 3 is 0.333333.... The '3' decimal value never ends. It just keeps going on forever. Sometimes this non-terminating decimal value is indicated by a small bar above the repeating part of the number:
>
> $$0.333\overline{33}$$
> $$0.1234\overline{123}$$
>
> (the top number indicates the value 0.333 33 33 33... the bottom number indicates 0.1234 123 123 123...
>
> Let x take on the value $0.99999\overline{99}$
>
> Then $10\text{x} = 9.99999\overline{99}$
>
> We now have two equations and 1 unknown variable x
>
> If we subtract the two we should be able to solve for the unknown variable:
>
> $$10\text{x} - x = 9.99999\overline{99} - 0.99999\overline{99}$$
> $$9\text{x} = 9$$
> $$x = 1$$
>
> But x is $0.99999\overline{99}$ not 1. How can this be?

There is no “trick” here. In a decimal based number system $0.99999\overline{99}$ is also 1. Think of it as a target. $0.99999\overline{99}$ Is so close to 1 in a base-ten number system that they are identical.

Computer systems have to represent base-ten number systems as base-two numbers. For integer values this is simple and the value is only limited by the number of base-two numbers that can be stored at one time. Each of these base-two numbers is called a binary-digit (for historical reasons) or more commonly a bit. The more bits a computer can use to store a number the bigger the decimal valued integer it can store.

But what about fractional Real numbers? Consider the value 0.1 base-ten. When you convert this to a base-two number system it becomes a non-terminating fractional base-two number. This means it can be difficult to represent something as simple as a dime in a digital computer.

What is needed is a method of mapping decimal Real numbers into base-two “Real” numbers.

Real numbers in computer techno-babble are called floating point numbers (because the decimal point can float to any place in the number). The magic code that does this for programmers is called the floating point package (FPP). Some FPPs are more sophisticated than are others. The FPP available in the iPhone is adequate for ***Rise And Set iP***.

How The FPP Affects The Time Calculations Accuracy

The point of this is that your accuracy is determined primarily by this FPP package on whatever device you are using. The algorithms yield an accuracy of ± 2 seconds. The iPad and iPhone FPP is good enough to give a general accuracy for the time calculations of ± 2 minutes. Add atmospheric refraction and this means that the accuracy of ***Rise And Set iP*** is approximately ± 4 minutes.

This accuracy is more than adequate for amateur astronomers or others trying to find rise and set times.

How The FPP Affects The Positional Accuracy

GPS positional accuracy is determined by several things. How accurate the Department Of Defense is willing to allow your equipment to resolve your position and some settings in the Apple iOS Applications Programmer Interface (API).

You can get within about ± 4 meters of your indicated latitude/longitude when tracking. Certainly close enough for setting up weekend after weekend or even year after year.

How Latitude Affects The Accuracy

As you get closer to either pole the accuracy of Rise And Set iP will decrease. As far south as 71° S latitude and 71° N are probably the limits of the accuracy. For a large part of the year it won't matter since the twilight will be either DARK or BRIGHT and rise and set become less frequent occurrences.

How Atmospheric Refraction Affects The Accuracy

The atmosphere is dirty! Dust, ash, a plethora of pollutants meteor dust and more contribute to the refraction of light in the atmosphere. The closer you look toward the horizon the more pollutants you are looking through. The closer to the zenith you look the fewer pollutants you have to look through. Unfortunately rise and set times involve looking toward horizons. In general the more clear the atmosphere the more accurate the prediction of Rise And Set iP will be. Most of the refraction effects are taken into account in the ± 4 minutes of accuracy quoted above.

Acknowledgments

Most of the formulae used in Rise And Set iP comes from code developed in 1970s before even the Apple I was conceived. The original code was cobbled together from celestial mechanics textbooks and NASA white papers until several books came onto the scene.

The first author that needs acknowledgment is Jean Meeus. The second is Peter Duffet-Smith. These two authors have several books that any amateur astronomer would covet.

These books are available through several sources (although not in electronic form: very disappointing!) The books by both authors are numerous and are be available from the following publishers: Amazon has all of both author's books, Willmann-Bell Publishing carry all of Jean Meeus' books and most of Peter Duffet-Smith's books, Cambridge Press carry all of Peter Duffet-Smith's books.